# REPORT

TO THE

# COMMISSIONERS

OF

# Public Charities and Correction,

ON THE

SCIENTIFIC PORTION OF THE CRUISE

OF THE

# "NAUTICAL SCHOOL-SHIP MERCURY,"

DURING THE

# WINTER OF 1871-72.

By J. W. S. ARNOLD, M.D.

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NEW YORK.
BELLEVUE PRESS.

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# REPORT.

At the request of the Commissioners of Public Charities and Correction, I have examined the documents of temperatures, of the soundings, &c., taken during the voyage of the Nautical School-ship Mercury, and have the honor to report:

The views of Dr. Carpenter with regard to a subaqueous or polar current, consisting of a stratum of cold water descending from the polar area, and occupying the deepest portions of the ocean, which, on reaching the equatorial region, becomes heated and rising to the surface is again carried back to the pole, thus giving rise to a constant, slow and gradual interchange between the equatorial and polar ocean waters,—these views are so well known since the cruises of H. M. Surveying-ship Porcupine, that it is not necessary to state them more concisely.

As the observations of Dr. Carpenter, Mr. Jeffreys and Prof. Thomson were made in the North Atlantic, it was desirable to continue the investigation of the temperatures and soundings to the region of the equator. As Dr. Carpenter held himself alone responsible for the "Polar current theory," in the report of the cruise of H. M. Surveying-vessel Porcupine in 1869, it would seem that the subaqueous current question was not satisfactory to the whole scientific corps who were engaged in the expedition. Of course it was of the utmost interest to carry on these soundings, and taking of temperatures, to the tropical Atlantic.

Under the auspices of the Commissioners of Public Charities and Correction, the practice cruises of the Nautical School-ship Mercury have been turned to good account in carrying on a series of observations on the temperatures

and soundings in the Tropical Atlantic and Caribbean Sea. In the report of the cruise of the School-ship Mercury in South Atlantic Ocean, 1870–71, by Prof. Henry Draper, will be found many facts of interest; and as far as the temperature records of the ocean waters show, they would seem to have some weight in favor of Dr. Carpenter's view. The cruise of the Mercury during the winter of 1870–71, showed the temperatures, &c., as near the equator as 8° 50' N. Lat. A second cruise during the winter of 1871–72 has given the results of observations made almost on the line of the equator itself, and, although through accident, it was not possible to obtain *bottom temperatures*, still the utmost thanks are due to the Honorable Board of Commissioners of Public Charities and Correction for the zeal with which they have entered into these important questions of ocean researches, and great credit is also due to Captain Giraud, Commander of the S. S. Mercury, for the able and conscientious manner in which his part of the work has been done.

The object of the second cruise of the Mercury was,

1st. To obtain the temperature of the air, surface of the water, and also at variable depths, and of the bottom, along the line of the equator, and above and below this line.

2d. To obtain specimens from the bottom as often as possible, and preserve these in alcohol.

3d. To collect samples of sea water at different depths, and preserve these so that they might be analyzed.

4th. In connection with the above, to record accurate barometric observations.

In order that the most accurate record of the temperatures should be obtained, a selection of thermometers of the "Miller Casella" construction were supplied; these instruments, however, had not been previously tested, and it was found that when they were sunk to a greater depth than 400 fathoms they were unable to stand the great pressure exerted upon them. After two of these instruments

were broken, no attempt to use those remaining, at a greater depth than 400 fathoms, was made.

Of course a great many points of interest, in reference to bottom temperatures, must be lost, but the facts which remain will be of some gain, and as such they are presented.

As the points of scientific interest of the cruise of the Mercury in 1871–72 are connected with that portion of the voyage during which the soundings, &c., were made, this report will only take notice of such. The remaining facts from the Log will be found elsewhere.

The soundings were commenced January 23d, 1872, and continued to May 9th.

The barometric observations from January 23d to February 6th are given in table I. It would seem that the pressure of the atmosphere were greater in the vicinity of the Canary Isles, and diminished as the coast of Brazil was approached.

The observations on the velocity and direction of currents between the vicinity of the Canary Islands and Cape St. Roque, being the positions in which soundings were taken, will be found in table II.

In glancing at table III, which corresponds in point of time with tables I and II, it will be noticed that the temperature of the surface of the water is in some instances higher than that of the air on the same date. May this be due to a flow of heated surface water from the equator, both north and south?

The temperature of air and surface water correspond at 0.44 S. Lat., while the difference between the two increases as the distance is increased from the equatorial line; this is apparent as far as Lat. 26.14 N. and *Lat. 24.02 S.

The great difference to be noticed in the temperatures of the surface water and that at 200 and 300 fathoms, is of considerable interest. Making all due allowance for the surface water being of a higher temperature than the air, it will be seen that there is a difference of more than 30°

*See table VII.

in many instances, at a depth of 300 fathoms. As it has been remarked, a point of the greatest importance would be to determine the temperature at intervals from the surface to the bottom, in this very location, but as the thermometers which were at hand could not be exposed to the pressure necessary to take deep temperatures, this part of the investigations must be considered incomplete.

We must now turn to the consideration of the deep soundings which were obtained during this part of the cruise. Table IV shows the depth of the ocean at the points determined. It would seem that along the equatorial line, at about 25 deg. W. longitude, there is a rising in the bed of the ocean, rather abrupt on the south, and more gradual on the north.

With reference to the specimens obtained from the bottom in this location, mention will be made further on.

Let us now turn our attention to that part of the cruise which was made along the South American Coast.

In the first place we may take a general survey of the barometric records, as shown in table V.

There seems to be nothing of importance in the variations here.

The currents as they were observed are given in table VI.

Along the coast of Brazil a series of temperatures were taken that are most striking in their significance, as the observations in this location extend below the line of the equator as far as 24 deg. 02 min. south latitude.

In some considerable number of instances, a series of soundings for temperature has been made of 200, 300, and 400 fathoms. It is curious to note the very cold area which is shown by the temperature at 400 fathoms, between 36 deg. north latitude and 20 deg. south latitude, with an average surface temperature of 80 deg.; the average for 200 fathoms is 52 deg.; 300 fathoms 46 deg.; and 400 fathoms 41 deg. 5 min. A sudden drop of 38 deg. 5 min. at 400 fathoms is worthy of note; and the difference of 10.5 deg., between the temperature at 300 and 400 fathoms, shows how

rapidly the water cools down at a comparatively short distance from the surface, (see table VII.)

From the annexed table (VIII) some explanation of the above phenomena may be gained. On comparing the table of bottom soundings with the temperatures at 300 and 400 fathoms, it will be seen that along and off from the coast-line of Brazil, there is a rising of the ocean bed along the equatorial line, just as there was shown to be at about longitude 25 deg. west.

If now the water is shallow here, the cold stratum (from the Poles?) must show itself at a comparatively short distance from the surface. Whether, as has been shown, the depth of 400 fathoms is sufficient to meet with the subaqueous Polar water, we are not in a position to advance an opinion.

The fact remains, however, that further north, where the depth of the ocean is greater, there is certainly a more uniform temperature as deep as 400 fathoms as our table shows.

Specimens were obtained from the bottom on a number of occasions, by means of Brooke's Deep Sea-sounding Detaching Apparatus. The sounding line was of cotton, one-seventh of an inch in diameter. The soundings were made from a boat as in the former cruise.

The results of microscopical examinations of the bottom specimens will be given further on.

The water which was obtained from different depths and locations, it has been deemed best not to investigate. The results obtained by Professor Draper, in Report for 1870–71, being considered as yielding sufficient information in reference to specific gravity, chemical constituents, &c.

## TABLE I.

| | Midnight. | 8 A.M. | 8 P.M. |
|---|---|---|---|
| January 23 | 30.31 | 30.28 | 30.30 |
| " 24 | 30.25 | 30.24 | 30.23 |
| " 25 | 30.30 | 30.25 | 30.27 |
| " 26 | 30.32 | 30.24 | 30.17 |
| " 27 | 30.18 | 30.16 | 30.13 |
| " 28 | 30.07 | 30.09 | 30.02 |
| " 29 | 30.07 | 30.03 | 30.10 |
| " 30 | 30.06 | 30.08 | 30.07 |
| " 31 | 30.02 | 30.11 | 30.15 |
| February 1 | 30.10 | 30.14 | 30.15 |
| " 2 | 30.15 | 30.18 | 30.18 |
| " 3 | 30.16 | 30.16 | 30.06 |
| " 4 | 30.09 | 30.08 | 30.03 |
| " 5 | 30.00 | 30.08 | 30.05 |
| " 6 | 30.07 | 30.09 | 30.06 |

## TABLE II.

Direction and Velocity of Currents between vicinity Canary Islands and off the coast of Cape St. Roque.

| Date. | Direction. | Velocity. |
|---|---|---|
| January 23 | S. | $\frac{1}{2}$ knot. |
| " 24 | S. by E. | " |
| " 28 | S. W. | " |
| " 29 | S. W. | $\frac{1}{4}$ " |
| " 30 | | No current. |
| " 31 | | " " |
| February 1 | | " " |
| " 2 | | No indication of current. |
| " 3 | | " " |
| " 4 | S. by W. | 1 knot. |
| " 5 | | No current. |
| " 6 | | Slight westerly current. |

## TABLE III.

| DATE. | Latitude. | Longitude. | Temp. of air. | Temp. of surface of water. | Temp. at 200 fathoms. | Temp. at 300 fathoms. |
|---|---|---|---|---|---|---|
| January 23 | 16°14' | 16°15' | 65° | 67° | | |
| " 24 | 24 17 | 17 37 | 67 | 68 | | |
| " 25 | 23 13 | 18 40 | 69 | 68 | | |
| " 26 | 20 13 | 20 39 | 65 | 67 | | |
| " 27 | 16 13 | 22 01 | 73 | 71 | | |
| " 28 | 11 55 | 23 05 | 72 | 72 | 54° | 48½° |
| " 29 | 10 55 | 23 22 | 72 | 73 | 52 | 48½ |
| " 30 | 8 50 | 24 10 | 75 | 76 | 51 | 49 |
| " 31 | 7 49 | 24 16 | 75 | 75 | 51 | 49 |
| February 1 | 5 44 | 24 51 | 77 | 78 | 50 | 49 |
| " 2 | 3 49 | 25 12 | 80 | 80 | 49 | 47 |
| " 3 | 1 20 | 24 57 | 77 | 80 | 50 | 46½ |
| " 4 | 44s | 25 38 | 82 | 82 | 52 | 49 |
| " 5 | 1 59 | 25 35 | 80 | 81 | 52 | 50 |
| " 6 | 2 58 | 26 36 | 79 | 81 | 52 | 49 |

## TABLE IV.

| | Latitude. | Longitude. | Fathoms |
|---|---|---|---|
| | NORTH. | WEST. | |
| January 23 | 26°14' | 16°15' | 1680 |
| " 24 | 24 47 | 17 37 | 1355 |
| " 29 | 10 55 | 23 22 | 2560 |
| " 31 | 7 49 | 24 16 | 2420 |
| February 1 | 5 44 | 24 57 | 2110 |
| " 2 | 3 49 | 25 12 | 2060 |
| " 3 | 1 20 | 24 57 | 1770 |
| " 4 | 44s. | 25 38 | 1890 |
| " 5 | 1 59 | 25 35 | 2340 |
| " 6 | 2 58 | 26 36 | 2530 |

## TABLE V.

| | Midnight. | 8 A.M. | 8 P.M. |
|---|---|---|---|
| February 7 | 30.03 | 30.00 | 30.08 |
| " 8 | 30.09 | 30.05 | 30.07 |
| " 9 | 30.02 | 30.05 | 30.02 |
| " 10 | 30.05 | 30.00 | 30.04 |
| " 11 | 30.03 | 30.03 | 30.03 |
| " 12 | 30.05 | 30.07 | 30.07 |
| " 13 | 30.05 | 30.07 | 30.05 |
| " 14 | 30.03 | 30.04 | 30.03 |
| " 15 | 30.01 | 30.05 | 30.02 |
| " 23 | 30.06 | 30.06 | 30.03 |
| " 24 | 30.08 | 30.05 | 30.09 |
| " 25 | 30.09 | 30.10 | 30.07 |
| " 26 | 30.04 | 30.12 | 30.13 |
| " 27 | 30.12 | 30.12 | 30.11 |
| " 28 | 30.05 | 30.12 | 30.10 |
| " 29 | 30.11 | 30.16 | 30.17 |
| March 1 | 30.12 | 30.15 | 30.18 |
| " 12 | 29.90 | 29.89 | 29.88 |
| " 13 | 29.91 | 29.91 | 29.98 |
| " 14 | 30.00 | 30.08 | 30.07 |
| " 15 | 30.15 | 30.16 | 30.12 |
| " 16 | 30.08 | 30.04 | 30.07 |
| " 17 | 30.06 | 30.01 | 30.08 |
| " 18 | 30.08 | 30.00 | 30.15 |
| " 19 | 30.15 | 30.17 | 30.15 |
| " 20 | 30.13 | 30.11 | 30.11 |
| " 21 | 30.10 | 30.09 | 30.12 |
| " 22 | 30.12 | 30.16 | 30.21 |
| " 23 | 30.14 | 30.18 | 30.19 |
| " 24 | 30.23 | 30.24 | 30.24 |
| " 25 | 30.24 | 30.09 | 30.12 |
| " 26 | 30.01 | 30.08 | 30.07 |
| " 27 | 30.10 | 30.09 | 30.13 |
| " 28 | 30.12 | 30.13 | 30.12 |
| " 29 | 30.09 | 30.08 | 30.01 |
| " 30 | 30.08 | 30.04 | 30.00 |
| " 31 | 30.04 | 30.04 | 30.04 |
| April 1 | 30.00 | 30.05 | 30.08 |
| " 2 | 30.09 | 30.08 | 30.08 |
| " 3 | 30.05 | 30.08 | 30.05 |
| " 4 | 30.04 | 30.05 | 30.02 |
| " 5 | 30.00 | 30.04 | 30.02 |
| " 6 | 30.06 | 30.05 | 30.03 |

## TABLE VI.

*Direction and Velocity of Currents along the coast of Brazil.*

| Date. | Direction. | Velocity. |
|---|---|---|
| February 7..... | | Slight westerly current. |
| " 8..... | | No current. |
| " 9..... | W. N. W. | $\frac{3}{4}$ knot. |
| " 10..... | W. by N. | $\frac{3}{4}$ " |
| " 11..... | S. W. | $\frac{1}{2}$ " |
| " 12..... | S. W. by S. | $\frac{1}{2}$ " |
| " 13..... | S. W. by S. | $\frac{1}{4}$ " |
| " 14..... | S. S. W. | $\frac{3}{4}$ " |
| March 18..... | | No current. |
| " 21..... | | " " |
| " 22..... | | " " |
| " 25..... | S. W. by S. | $\frac{3}{4}$ knot. |
| " 26..... | S. W. | $\frac{1}{2}$ " |
| " 28..... | W. S. W. | $\frac{1}{2}$ " |
| April 1..... | W. by N. | $\frac{1}{2}$ " |
| " 2..... | W. N. W. | $1\frac{1}{2}$ " |
| " 5..... | W. N. W. | $\frac{1}{2}$ " |
| " 6..... | | No current. |

# TABLE VII.

| | Latitude. | Longitude. | Temp. of air. | Temp. of surface of water. | Temp. at 200 fathoms. | Temp. at 300 fathoms. | Temp. at 400 fathoms. |
|---|---|---|---|---|---|---|---|
| | SOUTH. | WEST. | | | | | |
| Feb. 7 .... | 3°42′ | 27°14′ | 75 | 80 | | | |
| " 8 .... | 4 33 | 28 04 | 83 | 82 | 49 | 46 | |
| " 9 .... | 5 59 | 29 51 | 82 | 80 | 50 | 44 | |
| " 10 .... | 7 03 | 31 08 | 81 | 82 | 50 | 45 | |
| " 11 .... | 8 49 | 33 09 | 79 | 82 | 49 | 44 | |
| " 12 .... | 10 50 | 35 04 | 80 | 82 | 49 | 45 | |
| " 13 .... | 11 44 | 36 27 | 84 | 83 | 51 | 47 | |
| " 14 .... | 12 39 | 37 38 | 84 | 82 | 59½ | 50 | |
| Mar. 18 .... | 23 43 | 35 45 | 81 | 80 | 59 | 49 | |
| " 21 .... | 23 22 | 34 55 | 76 | 80 | 56 | 48 | 42 |
| " 22 .... | 24 02 | 32 59 | 80 | 80 | 56 | 49 | 43 |
| " 25 .... | 20 57 | 32 14 | 77 | 79 | 56 | 50 | 44 |
| " 26 .... | 18 15 | 32 29 | 79 | 80 | 56 | 47 | 42 |
| " 28 .... | 13 52 | 32 33 | 77 | 79 | 49 | 45 | 41 |
| April 1 .... | 4 29 | 35 25 | 79 | 82 | 53 | 48 | 42 |
| " 2 .... | 3 59 | 36 13 | 79 | 81 | 54 | 50 | 41 |
| " 5 .... | 1 02 | 39 34 | 80 | 81 | 50 | 44 | 40 |
| " 6 .... | 22 | 39 48 | 78 | 79 | 49 | 43 | 41 |
| " 7 .... | 36n. | 41 27 | 79 | 80 | 50 | 44 | 41 |
| May 2 .... | 20 50 | 67 01 | 77 | 79 | 60 | 56 | 50 |
| " 3 .... | 23 38 | 69 40 | 76 | 78 | 62 | 58 | 54 |
| " 4 .... | 25 50 | 71 10 | 75 | 76 | 62 | 60 | 54 |
| " 5 .... | 27 45 | 73 01 | 72 | 74 | 69 | 60 | 55 |
| " 6 .... | 29 26 | 73 42 | 68 | 71 | 63 | 61 | 55 |
| " 7 .... | 30 18 | 74 40 | 68 | 68 | 62 | 61 | 55 |
| " 8 .... | 31 52 | 74 28 | 73 | 75 | 63 | 61 | 57 |
| " 9 .... | 33 08 | 74 45 | 73 | 75 | 63 | 62 | 59 |
| " 10 .... | . .... | ..... . | .. | .. | .. | .. | .. |

## TABLE VIII.

| Date. | Latitude. | Longitude. | Fathoms. |
|---|---|---|---|
| February 8 | 4°33′s | 28°04′ | 2735 |
| " 9 | 5 59 | 29 51 | 2550 |
| " 11 | 8 49 | 33 09 | 2290 |
| " 12 | 10 50 | 33 04 | 1940 |
| " 13 | 11 44 | 36 27 | 1580 |
| " 14 | 12 39 | 37 38 | 1130 |
| March 18 | 23 43 | 35 45 | 2160 |
| " 22 | 24 02 | 32 59 | 2530 |
| " 25 | 20 57 | 32 14 | 2220 |
| " 26 | 18 15 | 32 29 | 2255 |
| " 28 | 13 52 | 32 33 | 1630 |
| April 2 | 3 59 | 36 13 | 1610 |
| " 6 | 22 | 39 48 | 1625 |

## MICROSCOPICAL EXAMINATION

Of Specimens of Deep Sea Soundings, taken during cruise of the "Nautical School-ship Mercury," 1871–2.

After having examined, with some considerable care, the specimens of soundings, and having also had the opinion of my most esteemed friend Prof. H. L. Smith, of Hobart College, who has kindly given a close examination to a number of specimens, I would offer the following results for consideration, which embody Prof. Smith's investigations with my own.

In looking over the specimens taken at points distant from the equator, nothing of special interest was found. A number of specimens taken from the immediate vicinity of the equator seem to present some facts of interest. All the specimens in these situations consisted of calcareous mud finely divided. In the specimens examined by Prof. Smith no sand was found, and those which I looked over contained no evidence of this constituent. Diatomaceæ, Polycystinæ and Foraminiferæ were in all the specimens, with the exception of that taken at 18° 15' S. Lat. 32° 29' W. Long., depth 2,255 fathoms, which contained Foraminif-

eræ alone. Although several quills were obtained from this sounding, no other forms besides Foraminiferæ were to be found. The Polycystinæ were living, in some instances, when the soundings were made. This was shown to be the case, from the fact that the siliceous fragments contained and were enveloped by the sarcode. (Prof. Smith.) The soundings richest in Polycystinæ, Foraminiferæ and Diatomaceæ were those immediately south of the equator, "owing, probably," says Prof. Smith, "to the influence of the north-west branch of the great equatorial current, deflected to the south of the island of St. Paul." One form found in two of these soundings is well known as occurring in Gulf stream soundings off Florida, and also in soundings in the Indian Ocean and Bengal. Several forms described by Bailey as occurring in Lieut. Brooke's soundings in the sea of Kamtschatka, and also several figured by Ehrenberg from Capt. Berryman's soundings in the North Atlantic are found in these soundings—with one exception* they were all Polycystinæ. (Prof. Smith.) This would seem to be a point of some interest, as the Polycystinæ were living, and perhaps, as Prof. Smith states, the Foraminiferæ.

In conclusion, I add a list of most of the forms found in five soundings, just above and below the equator, which have been kindly made out for me by Prof. Smith. Many of these forms were to be seen in the other specimens which have not been so closely noticed; in fact, the commoner diatoms are so widely distributed that they are of comparative unimportance in this connection.

No. 1. Lat. N. 3° 49′. Lon. W. 25° 12′. Depth 2,060 fathoms.

| FORAMINIFERÆ. | DIATOMACEÆ. |
|---|---|
| Rosalina laevigata. | Coscinodiscus minor. |
| Textularia globulosa. | " lineatus. |
| Rotalia turgida. | " radiatus. |
| " perforata. | No sponge spiculae or Polycystinæ. |
| " globulosa. | |
| Strophoconus ovum.? | |
| Operculariа? fragments. | |

* This exception is the Rhizopod, figured by Bailey in Amer. Journal of Science, 2d series, vol. 22, pl. 1, fig. 2 as *Cadium Marinum*. (Smith.)

No. 2. N. Lat. 1° 20′. W. Long. 24° 57′. Depth 1,770 fathoms.

FORAMINIFERÆ.
Planularia porosa.
Rotalia turgida.
" globulosa.
" perforata.
Rosalina laevigata.
POLYCYSTINÆ.
Eucystridium lineatum.
Lychnocanium Lucema?
Lithocyclia ocellus?
DIATOMACEÆ.
Coscinodiscus minor, Euodia gibba small and rare.
A few small spiculae of sponge.

No. 3. S. Lat. 1° 59′. W. Long. 25° 35′. Depth 2,340 fathoms.

FORAMINIFERÆ.
Globigerina fragments.
Rosalina laevigata.
Rotalia turgida.
" perforata.
Robulina crystallinæ.
RHIZOPOD.?
Cadium marinum. B.
DIATOMACEÆ.
Endictya oceanica.
Navicula lyra.
Rhizosolenia styliformis?
Euodia gibba, large.
} Asterolampa arachne.
} Spatangidium. De Breb.
Triceratium obtusum.
Synedra tabulata.
Coscinodiscus minor.
" lineatus.
" eccentricus.
" radiatus.
" concimnus?
Melosira granulata — a few particles of this form usually considered a fresh water species, were found in this sounding.
POLYCYSTINÆ.
Haliomma Beroes.
" hexagonum.
Cornutella profunda.
Eucystidium lineatum.
" nereidum.
" tumidulum.
" Montglofierii.
Podocyrtis papalis.
" gracilipes.
Dictyophimus. " B.
Perichlamidium venustum. B.
Cenophora plutonis.
Hymenastrum——?
Rhopalastrum lagenosum.
Strophocunus——?
Sponge spiculae were tolerably abundant.

No. 4. S. Lat. 4° 33′. W. Long. 28° 04′. Depth 2,735 fathoms.

FORAMINIFERÆ.
Planulina.
Rosalina laevigata.
Nodosari——?

DIATOMACEÆ.
Euodia gibba large and small
Coscinodiscus minor.
" radiolatus.
" lineatus.
Triceratium obtusum.
Various forms of Dictyochia and sponge spiculae.

POLYCYSTINÆ.
Eucystidum lineata.
" ——?
Lychnocanium.——?
Comutella stilligera.
" clathrata.
Cenophora plutonis?
Hymenastrum——?
Rhopulastrum lagenosum?
Podocyrtis papalis.
Dictyospiris——?
Haliomma radians.
" medusa
" acquoreæ.
" Humboldtii.
" Beroes.

No. 5. S. Lat. 18° 15′. W. Long. 32° 29′. Depth 2,255 fathoms.

FORAMINIFERÆ.
Rotalia perforata.
" turgida.
Rosalina laevigata.
Nodosaria——?
Textularia striata.
" globulosa.

In conclusion, it may be stated that imperfect as has been the manner in which the writer of this report has fulfilled his task, it is not from want of desire to do his duty, but from dealing with a subject that is not as familiar as it might be. All of which is with respect submitted to the most Honorable Board of Commissioners of Public Charities and Correction.

J. W. S. ARNOLD, M. D.
*Curator to Bellevue Hospital.*